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| 10/052,020 | 01/17/2002 | Nathan D. Cahill | 83507DMW RLW | 1225 |

7590 10/06/2005

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| EXAMINER | |
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| QUIETT, CARRAMAH J | |
| **ART UNIT** | **PAPER NUMBER** |
| 2612 | |

DATE MAILED: 10/06/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/052,020 | CAHILL ET AL. | |
| | Examiner | Art Unit | |
| | Carramah J. Quiett | 2612 | |

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *03 June 2005*.

2a)☒ This action is FINAL. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-12 and 23-34* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-12 and 23-34* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *17 January 2002* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

## DETAILED ACTION

### *Response to Amendment*

1. The amendment(s), filed on 06/03/2005, have been entered and made of record. Claims 1-12 and 23-34 are pending. The Applicant has canceled claims 13-22 and added claims 28-34.

### *Response to Arguments*

2. Applicant's arguments filed 06/03/2005 have been fully considered but they are not persuasive.

In response to Applicant's comments regarding the Examiner's previous Office Action, the Examiner respectfully disagrees. The Applicant's remarks stated in relation to "polar coordinates":

> "The rejection of Claims 1-27 is not fully understood. The rejection repeated refers to the imager of Carlson as having a three dimensional shape: "the cylindrical imager" (page 7, line 6) and "the spherical imager" (page 7, line 21). Carlson does not disclose this, nor does use of polar coordinates mandate a three dimensional shape. A definition states: "POLAR COODINATES Any point in a plane can be identified by its distance from the origin (r) and its angle of inclination (Θ)." (Dictionary of Mathematical Terms, 2nd ed., D. Downing, Barron's, Hauppauge, New York, (1995), page 247). Figure 3 of Carlson illustrates the imager as planar."

Although the Applicant has provided a definition from a mathematical dictionary, an Information Disclosure Statement (IDS) (PTO -1449) along with a copy of this non-patent literature (NPL) has not been provided with the Applicant's amendments and arguments.

In order to provide the Applicant with a full understanding of the rejection of claims 1-27, the Examiner will respectfully explain what a polar coordinate system mandates. While a definition of polar coordinates is considered to be any point in a plane can be identified by its distance from the origin (r) and its angle of inclination (Θ), the principles for a polar coordinate system is mandated for either a two dimensional (2-D) system or a three dimensional (3-D) system. For a 3-D system, polar coordinates can be applied to a surface with cylindrical coordinates or spherical coordinates. Please refer the cited prior art entitled, "The Penguin Dictionary of Mathematics (1998)." This particular dictionary teaches general, spherical, and cylindrical coordinate concepts in relation to polar coordinates.

Respectfully (once again) based on the teachings of "The Penguin Dictionary of Mathematics (1998)", it is inherent for the imager of Carlson to be a sphere or a cylinder because Carlson states that the imager has polar coordinates (Carlson, fig. 2A, col. 4, lines 24-42) and can be applied to the imager 300 in fig. 3 of Carlson (col. 5, lines 13-33).

In regards to claim 1, the Applicant also states that the optical image produced by the optical system has a perspective distortion relative to the surface of the imaging sensor and the distribution of imaging elements on that surface compensates for the perspective distortion of the optical image. After explaining what Carlson's imaging system is applicable thereto, the Applicant states that distortion is not addressed. The Examiner respectfully disagrees. In several places throughout Carlson's disclosure, he teaches how to compensate for blurring and aliasing, which corresponds to distortion and warping, with respect to the pattern of the picture element of the imager. Please read Carlson's Abstract and col. 5, line 14 – col. 6, line 9.

Accordingly, the rejections for claims 2-10 remain the same as depending from claim 1.

Regarding claims 11-12, the Applicant quoted an excerpt from the Examiner's previous rejection. He wrote the rejection states:

> "Carlson's invention is related to wide view images (Carlson, col. 2, line 67 – col. 3, line 1). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made for Carlson to implement a system including a processor for combining the images into a composite image…"

Well, the Examiner respectfully disagrees. That excerpt from the Examiner's previous rejection was written as:

> "…Similar to Ribera, Carlson's invention is related to wide view images (Carlson, col. 2, line 67 – col. 3, line 1). In light of the teaching of Ribera, it would have been obvious to one of ordinary skill in the art at the time the invention was made for Carlson to implement a system including a processor for combining the images into a composite image…"

Ribera teaches that the imager and the lens are adapted to detect the widest possible viewing angle (col. 2, lines 28-59). In light of this teaching and the other teachings of Ribera, it is apparent for Carlson to modify the system with a processor for combining a composite image, thereby the processor can operate directly on the output signal without having to warp the image data in order to display panoramic images over a substantially 360 degree by 360 degree range of angles (Ribera, col. 1, lines 36-39).

Also for claim 11, the Applicant asserts that Carlson does not disclose the use of a cylindrical or spherical imager, nor does Carlson address distortion. The Examiner respectfully disagrees. For claims 11-12, the use of a cylindrical or spherical imager is not claimed.

Nevertheless, it is inherent for the imager of Carlson to be a sphere or a cylinder because Carlson states that the imager has polar coordinates (Carlson, fig. 2A, col. 4, lines 24-42) and can be applied to the imager 300 in fig. 3 of Carlson (col. 5, lines 13-33). As explained earlier, polar coordinates can consist of a 2-D system as will as a 3-D system. Although the Applicant does not use the word "distortion" in claims 11-12, the word "warp" is used. In several places throughout Carlson's disclosure, he teaches how to compensate for blurring and aliasing, which corresponds to distortion and warping, with respect to the pattern of the picture element of the imager. Please read Carlson's Abstract and col. 5, line 14 – col. 6, line 9.

Accordingly, the rejection for claim 12 remains the same as depending from claim 11.

Regarding claim 23, the Applicant, once again, asserts that Carlson does not address distortion and does not disclose image warping. As stated in the paragraphs above, Carlson teaches how to compensate for blurring and aliasing, which corresponds to distortion and warping, with respect to the pattern of the picture element of the imager. Please read Carlson's Abstract and col. 5, line 14 – col. 6, line 9.

Additionally, in the remarks on page 11, the Applicant asks the question, "What would motivate one of skill in art to make such a composite image?" The Examiner provided a motivation in the Examiner's previous office action as follows:

> "...Similar to Huang, Carlson discloses an imaging system for image warping/ blurring improvements (Carlson, Abstract). In light of the teaching of Huang, it would have been obvious to one of ordinary skill in the art at the time the invention was made for Carlson to provide a method of generating a composite digital image from at least two

source digital images in order *to provide 360° panoramic stereo images* (Huang, section 2, page 197, paragraphs 2-4)."

Accordingly, the rejections for claims 24-27 remain the same as depending from claim 23.

### *Claim Rejections - 35 USC § 102*

3. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

4. **Claims 1-5, 8, 10, 30-31, and 33** are rejected under 35 U.S.C. 102(b) as being anticipated by Carlson (U.S. Pat. #4,554,585).

For **claim 1**, Carlson teaches an electronic imaging system (fig. 1, 100, 110, 108) for capturing an image of a scene (col. 2, lines 57-62), said imaging system comprising:

(a) an optical system (fig. 1, 100) for producing an optical image of the scene (col. 2, line 63 – col. 3, line 10);

(b) an imaging sensor (solid-state imager, col. 2, lines 63-65) having a surface in optical communication (col. 2, line 66 – col. 3, line 2) with the optical system; and

(c) a plurality of imaging elements (fig. 2a) distributed on the surface of the imaging sensor (col. 4, lines 13-23), said imaging elements converting the optical image into a corresponding output signal (col. 3, lines 4-7), said imaging elements being located according to a distribution representable by a nonlinear function in which the relative density of the distributed imaging elements is greater toward the center of the sensor (col. 4, lines 28-33),

wherein the distribution provides physical coordinates for each of the imaging elements corresponding to a projection of the scene onto a non-planar surface (col. 4, lines 24-28);

wherein said optical image produced by the optical system has a perspective distortion relative to the surface of the imaging sensor and the distribution of imaging elements on that surface compensates for the perspective distortion. Please read Carlson's Abstract, col. 4, lines 24-28, and col. 5, line 14 – col. 6, line 9.

For **claim 2,** Carlson further discloses a system wherein the non-planar surface is inherently a cylinder. This is inherent because in col. 4, lines 28-33, Carlson states that the discrete picture elements 200 are symmetrically disposed about the center of a polar-coordinate spatial distribution pattern.

For **claim 3,** Carlson further discloses a system wherein the non-planar surface is a sphere. This is inherent because in col. 4, lines 28-33, Carlson states that the discrete picture elements 200 are symmetrically disposed about the center of a polar-coordinate spatial distribution pattern.

For **claim 4,** Carlson further discloses an optical system that includes a lens (fig. 3, 304) and the axis of rotation of the cylinder intersects a nodal point of the lens. As stated before, it is inherent that Carlson's non-planar surface is a cylinder because in col. 4, lines 28-33, Carlson states that the discrete picture elements 200 are symmetrically disposed about the center of a polar-coordinate spatial distribution pattern. As illustrated in fig. 3, the center of the cylinder is located at a nodal point of the lens because the imager is located along the optical axis of the lens (col. 5, lines 13-19). The imager senses light from the lens via a low-pass filter (col. 5, lines 26-29).

For **claim 5**, Carlson further discloses a system wherein the optical system includes a lens and the center of the sphere is located at a nodal point of the lens. As stated before, it is inherent that Carlson's non-planar surface is a sphere because in col. 4, lines 28-33, Carlson states that the discrete picture elements 200 are symmetrically disposed about the center of a polar-coordinate spatial distribution pattern. As illustrated in fig. 3, the center of the sphere is located at a nodal point of the lens because the imager is located along the optical axis of the lens (col. 5, lines 13-19). The imager senses light from the lens via a low-pass filter (col., 5, lines 26-29).

For **claim 8**, Carlson further discloses a system wherein the imaging sensor is a charge-coupled device (col. 2, lines 63-65).

For **claim 10**, Carlson further discloses a system wherein the output signal includes data from a plurality of images (col. 2, lines 19-33).

For **claim 30**, Carlson discloses an electronic imaging system (fig. 1, 100, 110, 108) comprising:

an optical system (fig. 1, 100) transmitting an optical image (col. 2, line 63 – col. 3, line 10); and

a plurality of imaging elements (fig. 2a) receiving said optical image and converting said optical image into a corresponding output signal (col. 3, lines 4-7), said imaging elements having a distribution defining a plane (col. 4, lines 13-23), said distribution representing a nonlinear function corresponding to a projection of the scene onto a non-planar surface (col. 4, lines 24-33); wherein said optical image has a perspective distortion relative to said plane and said distribution of said imaging elements on said plane compensates for said perspective distortion. Please read Carlson's Abstract, col. 4, lines 24-28, and col. 5, line 14 – col. 6, line 9.

For **claim 31**, Carlson discloses the system wherein said imaging elements are linearly addressed (col. 4, lines 13-42).

For **claim 33**, Carlson teaches an electronic imaging system (fig. 1, 100, 110, 108) for capturing an image of a scene (col. 2, lines 57-62), said imaging system comprising:

an optical system (fig. 1, 100) for producing an optical image of the scene (col. 2, line 63 – col. 3, line 10);

an imaging sensor (solid-state imager, col. 2, lines 63-65) having a surface in optical communication (col. 2, line 66 – col. 3, line 2) with the optical system; and

a plurality of imaging elements (fig. 2a) distributed on the surface of the imaging sensor (col. 4, lines 13-23), said imaging elements converting the optical image into a corresponding output signal (col. 3, lines 4-7);

wherein said optical image has a perspective distortion relative to said surface and said imaging elements on said surface of said imaging sensor have a non-linear distribution compensatory of said perspective distortion and linear addressing (col. 4, lines 13-42). Please read Carlson's Abstract, col. 4, lines 24-28, and col. 5, line 14 – col. 6, line 9.

### *Claim Rejections - 35 USC § 103*

5. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

6. **Claims 6-7** are rejected under 35 U.S.C. 103(a) as being unpatentable over Carlson (U.S. Pat. #4,554,585) in view of Hsieh et al. (U.S. Pat. #6,798,923).

For **claim 6**, Carlson does not specifically disclose a system wherein the radius of the cylinder is a function of a focal length of the optical system. However, in col. 4 lines 28-33, Carlson states that the discrete picture elements 200 are symmetrically disposed about the center of a polar-coordinate spatial distribution pattern. Additionally, in figure 2a, Carlson illustrates an image sensor where there are radial changes with respect to the high/low resolution periphery (col. 4, lines 24-42). The center of the cylindrical imager, which senses light from the lens via a low-pass filter (col. 5, lines 26-29), is located along the optical axis of the lens as illustrated in fig. 3 (col. 5, lines 13-19). In the same field of endeavor, Hsieh explains how to remove the effects of panoramic distortion of images projected on a cylinder (col. 3, line 65 – col. 4, line 40) by utilizing equations (1) – (4) to obtain coordinates for the corresponding pixel of the image plane in the cylindrical map. Since Hsieh states that the radius is equal to the focal length, the focal length will change with respect to the radius. In light of the teaching of Hsieh, it would have been obvious to one of ordinary skill in the art at the time the invention was made for Carlson to implement a system wherein the radius of the cylinder is a function of a focal length of the optical system in order to permit a predetermined mapping of the image onto the sensor.

For **claim 7**, Carlson does not specifically disclose a system wherein the radius of the sphere is a function of a focal length of the optical system. However, in col. 4 lines 28-33, Carlson states that the discrete picture elements 200 are symmetrically disposed about the center of a polar-coordinate spatial distribution pattern. Additionally, in figure 2a, Carlson illustrates an image sensor where the radius changes with respect to the high/low resolution periphery (col. 4, lines 24-42). The center of the spherical imager, which senses light from the lens via a low-pass filter (col. 5, lines 26-29), is located along the optical axis of the lens as illustrated in fig. 3 (col.

5, lines 13-19). In the same field of endeavor, Hsieh explains how to remove the effects of panoramic distortion of images projected on a sphere (col. 3, line 65 – col. 4, line 40). Although, Hsieh gives an example of the cylindrical geometry, Carlson utilizes polar coordinates as explained in claim 3. Since Hsieh states that the radius is equal to the focal length, the focal length will change with respect to the radius. In light of the teaching of Hsieh, it would have been obvious to one of ordinary skill in the art at the time the invention was made for Carlson to implement a system wherein the radius of the sphere is a function of a focal length of the optical system in order to permit a predetermined mapping of the image onto the sensor.

7. **Claims 11-12, 32, and 34** are rejected under 35 U.S.C. 103(a) as being unpatentable over Carlson (U.S. Pat. #4,554,585) in view of Ribera et al. (U.S. Pat. # 6,603,503).

For **claim 11**, Carlson discloses a system with a moveable television camera that produces a video signal, which is coupled to an image signal processor. Carlson's image signal processor, which analyzes the image defined by the video signal to determine the exact whereabouts of a particular object in field of view, can inherently operate directly on the output signal without having to warp the image data (col. 3, lines 33-46). However, Carlson does not teach a system including a processor for combining the images into a composite image.

In the same field of endeavor, Ribera discloses a system including a processor (Ribera, fig. 4, ref. 10) for combining the images into a composite image, thereby the processor can operate directly on the output signal without having to warp the image data (Ribera, col. 6, lines 10-21 and col. 4, lines 51-55). Similar to Ribera, Carlson's invention is related to wide view images (Carlson, col. 2, line 67 – col. 3, line 1). In light of the teaching of Ribera, it would have been obvious to one of ordinary skill in the art at the time the invention was made for Carlson to

implement a system including a processor for combining the images into a composite image, thereby the processor can operate directly on the output signal without having to warp the image data in order to display panoramic images over a substantially 360 degree by 360 degree range of angles (Ribera, col. 1, lines 36-39).

For **claim 12**, Carlson does not further disclose a system including a projector for projecting the composite image onto a planar surface. However, Ribera further discloses a system including a projector (Ribera, fig. 4, ref. 20) for projecting the composite image onto a planar surface (Ribera, col. 6, lines 10-21). Similar to Ribera, Carlson's invention is related to panoramic/wide view images (Carlson, col. 2, line 67 – col. 3, line 1). In light of the teaching of Ribera, it would have been obvious to one of ordinary skill in the art at the time the invention was made for Carlson to implement a system including a projector for projecting the composite image onto a planar surface in order to display panoramic images over a substantially 360 degree by 360 degree range of angles (Ribera, col. 1, lines 36-39).

For **claim 32**, Carlson discloses a system with a moveable television camera that produces a video signal, which is coupled to an image signal processor. Carlson's image signal processor, which analyzes the image defined by the video signal to determine the exact whereabouts of a particular object in field of view, can inherently operate directly on the output signal without having to warp the image data (col. 3, lines 33-46). However, Carlson does not teach a system further including a processor combining said output signal and one or more additional output signals into a composite image without warping.

In the same field of endeavor, Ribera discloses a system further including a processor (Ribera, fig. 4, ref. 10) combining said output signal and one or more additional output signals

into a composite image without warping. (Ribera, col. 6, lines 10-21 and col. 4, lines 51-55). Similar to Ribera, Carlson's invention is related to wide view images (Carlson, col. 2, line 67 – col. 3, line 1). In light of the teaching of Ribera, it would have been obvious to one of ordinary skill in the art at the time the invention was made for Carlson to implement a system further including a processor combining the output signal and one or more additional output signals into a composite image without warping in order to display panoramic images over a substantially 360 degree by 360 degree range of angles (Ribera, col. 1, lines 36-39).

Regarding **claim 34,** this claim is an apparatus claim corresponding to an apparatus claim 32. Therefore, apparatus claim 34 is analyzed and rejected as previously discussed with respect to claim 32.

8. **Claims 23-29** are rejected under 35 U.S.C. 103(a) as being unpatentable over Carlson (U.S. Pat. #4,554,585) in view of Huang et al. ("Panoramic Stereo imaging System with Automatic Disparity Warping and Seaming," Graphical Models and image Processing, Vol. 60, No. 3, May 1998, pp. 196-208.)

For **claim 23**, Carlson teaches a method (fig. 1, 100, 110, 108) comprising: (a) generating at least two source digital images corresponding to said optical images, from an imaging sensor having imaging elements distributed, in a plane, so as to compensate for said perspective distortion (col. 2, lines 63-65; col. 3, lines 4-7 and 47; col. 4, lines 28-33). This claim differs from Carlson in that he does not teach a method of generating a composite digital image from at least two source digital images, said method comprising:

(b) combining the source digital images without further correction of said perspective distortion to form a composite digital image.

In the same field of endeavor, Huang teaches a method of generating a composite digital image from at least two source optical images (page 197, section 3.1, paragraph 1) having perspective distortion relative to a planar surface, said method comprising: (b) combining the source digital images to form a composite digital image (page 200, section 3.5). Additionally, Huang's panoramic stereo imaging system inherently has an imaging sensor because his system includes two cameras for the left-eye and the right-eye (page 197, section 3.1, paragraph 2). This system generates focused images by selecting the correctly focused image for each sensor (pages 197-198, section 3.2, paragraphs 1-2). Please see figs. 5-6 and read pages 199-200, section 3.4, paragraphs 1-2. Similar to Huang, Carlson discloses an imaging system for image warping/ blurring improvements (Carlson, Abstract). In light of the teaching of Huang, it would have been obvious to one of ordinary skill in the art at the time the invention was made for Carlson to provide a method of generating a composite digital image from at least two source digital images in order to provide 360° panoramic stereo images (Huang, section 2, page 197, paragraphs 2-4).

For **claim 24**, Carlson, as modified by Huang, further discloses a system including a projector for projecting the composite image. On pages 204-207, Huang explains and illustrates the experimental results of the panoramic stereo imaging system. He demonstrates how the image distortion correction of the composite image is projected. In light of the teaching of Huang, it would have been obvious to one of ordinary skill in the art at the time the invention was made for Carlson to provide a method of including a projector for projecting the composite

image onto a planar surface in order to provide 360° panoramic stereo images (Huang, section 2, page 197, paragraphs 2-4).

For claim 25, Carlson does not teach a method wherein the two source digital images overlap in overlapping pixel regions. Huang teaches a method wherein the two source digital images overlap in overlapping pixel regions (Huang, page 207, section 5 – Conclusion). In light of the teaching of Huang, it would have been obvious to one of ordinary skill in the art at the time the invention was made for Carlson to provide a method wherein the two source digital images overlap in overlapping pixel regions in order to provide 360° panoramic stereo images (Huang, section 2, page 197, paragraphs 2-4).

For claim 26, Carlson, as modified by Huang, further discloses a method wherein said perspective distortion corresponds to a projection of the scene onto a cylinder. In col. 4 lines 28-33, Carlson states that the discrete picture elements 200 are symmetrically disposed about the center of a polar-coordinate spatial distribution pattern. In light of the teaching of Huang, it is well known in the art for coordinates of a cylinder to be known as polar-coordinates. Also, please read Huang, pages 199-200, section 3.4, paragraphs 1-2.

For claim 27, Carlson, as modified by, Huang further discloses a system said perspective distortion corresponds to a projection of the scene onto a sphere. In col. 4 lines 28-33, Carlson states that the discrete picture elements 200 are symmetrically disposed about the center of a polar-coordinate spatial distribution pattern. In light of the teaching of Huang, it is well known in the art for coordinates of a sphere to be known as polar coordinates. In the disclosure of Huang, 3-D cameras are utilized in the panoramic stereo imaging system. Although he uses a cylindrical surface to describe his panoramic stereo imaging system, Huang makes readers aware of the

need for image distortion correction for images at the proper positions of a sphere as well as a cylinder.

For **claim 28**, Carlson teaches a method (fig. 1, 100, 110, 108) comprising: generating a digital image corresponding to said optical image using said image sensor, on imaging elements of said image sensor, said imaging elements being located according to a non-linear distribution representable by a projection of the scene onto a non-planar surface (col. 2, lines 63-65; col. 3, lines 4-7 and 47; col. 4, lines 28-33). This claim differs from Carlson in that he does not teach a method of generating a composite digital image, said method comprising: producing an optical image of a scene on an image sensor having a planar surface, said optical image having a perspective distortion relative to said planar surface.

In the same field of endeavor, Huang teaches a method of generating a composite digital image (page 197, section 3.1, paragraph 1), said method comprising: producing an optical image of a scene on an image sensor having a planar surface, said optical image having a perspective distortion relative to said planar surface (page 197, section 3.1, paragraph 1). Additionally, on pages 204-207, Huang explains and illustrates the experimental results of the panoramic stereo imaging system. He demonstrates how the image distortion correction of the composite image is projected on a planar surface. In light of the teaching of Huang, it would have been obvious to one of ordinary skill in the art at the time the invention was made for Carlson to provide a method of generating a composite digital image, said method comprising: producing an optical image of a scene on an image sensor having a planar surface, said optical image having a perspective distortion relative to said planar surface in order to provide 360° panoramic stereo images (Huang, section 2, page 197, paragraphs 2-4).

For **claim 29**, Carlson, as modified by Huang, teaches a method wherein said imaging elements are linearly addressed (Carlson, col. 4, lines 13-42).

***Conclusion***

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

| | |
|---|---|
| The Penguin Dictionary of Mathematics (1998). Retrieved 28 September 28, 2005. Available from xreferplus. http://www.xreferplus.com/entry/144128. | Polar Coordinate System |
| The Penguin Dictionary of Mathematics (1998). Retrieved 28 September 28, 2005. Available from xreferplus. http://www.xreferplus.com/entry/1441659. | Spherical Coordinate System |
| The Penguin Dictionary of Mathematics (1998). Retrieved 28 September 28, 2005. Available from xreferplus. http://www.xreferplus.com/entry/1439544. | Cylindrical Coordinate System |

10. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Carramah J. Quiett whose telephone number is (571) 272-7316. The examiner can normally be reached on 8:00-5:00 M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, NgocYen Vu can be reached on (571) 272-7320. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

CJQ
September 29, 2005

NGOC-YEN VU
PRIMARY EXAMINER

| *Notice of References Cited* | Application/Control No. 10/052,020 | Applicant(s)/Patent Under Reexamination CAHILL ET AL. | |
|---|---|---|---|
| | Examiner Carramah J. Quiett | Art Unit 2612 | Page 1 of 1 |

U.S. PATENT DOCUMENTS

| * | | Document Number Country Code-Number-Kind Code | Date MM-YYYY | Name | Classification |
|---|---|---|---|---|---|
| | A | US- | | | |
| | B | US- | | | |
| | C | US- | | | |
| | D | US- | | | |
| | E | US- | | | |
| | F | US- | | | |
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| | I | US- | | | |
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| | K | US- | | | |
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FOREIGN PATENT DOCUMENTS

| * | | Document Number Country Code-Number-Kind Code | Date MM-YYYY | Country | Name | Classification |
|---|---|---|---|---|---|---|
| | N | | | | | |
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| | S | | | | | |
| | T | | | | | |

NON-PATENT DOCUMENTS

| * | | Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages) |
|---|---|---|
| | U | Polar Coordinate System. The Penguin Dictionary of Mathematics (1998). Retrieved 28 September 28, 2005. Available from xreferplus. http://www.xreferplus.com/entry/144128. |
| | V | Spherical Coordinate System. The Penguin Dictionary of Mathematics (1998). Retrieved 28 September 28, 2005 Available from xreferplus. http://www.xreferplus.com/entry/1441659. |
| | W | Cylindrical Coordinate System. The Penguin Dictionary of Mathematics (1998). Retrieved 28 September 28, 2005. Available from xreferplus. http://www.xreferplus.com/entry/1439544. |
| | X | |

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
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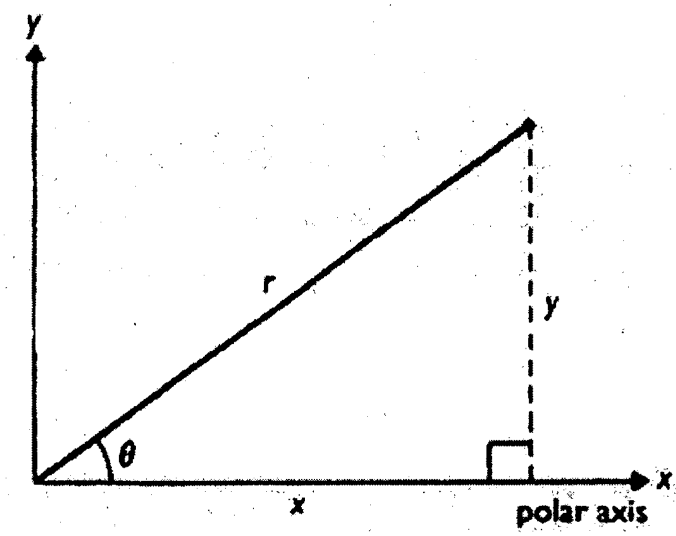
# polar coordinate system

A coordinate system in which the position of a point is determined by the length of a line segment from a fixed origin together with the angle or angles that the line segment makes with a fixed line or lines. The origin is called the *pole* and the line segment is the *radius vector (r)*. In two dimensions, one reference axis is required (called the *polar axis*). The angle θ between the polar axis and the radius vector is called the *vectorial angle* (other terms are *polar angle*, *azimuth*, *amplitude*, and *anomaly*). By convention, positive values of θ are measured in an anticlockwise sense, negative values in a clockwise sense. The coordinates of the point are then specified as $(r, \theta)$. Polar coordinates in a plane are useful for dealing with systems that have central symmetry.




**polar coordinate system**

It is possible to change between polar and Cartesian coordinates. If the pole of the polar system coincides with the origin of the Cartesian system, and if the polar axis coincides with the x-axis, then a point $(r, \theta)$ has Cartesian coordinates given by

$$x = r\cos\theta, \qquad y = r\sin\theta$$

For example, the point with polar coordinates (3,90°) has Cartesian coordinates (0, 3). Similarly, a point $(x, y)$ in a Cartesian coordinate system has polar coordinates given by

$$r = \sqrt{(x^2 + y^2)}, \qquad \theta = \tan^{-1}(y/x)$$

where θ is such that

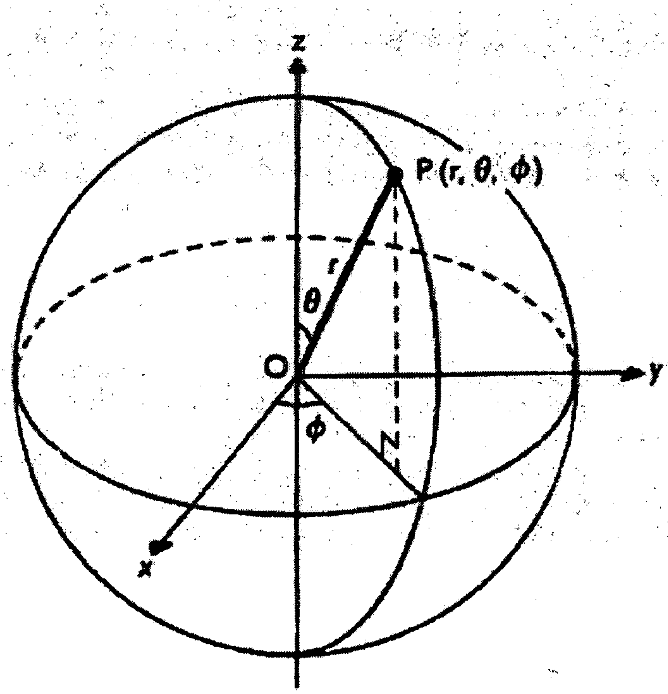
$$x : y : r = \cos\theta : \sin\theta : 1$$

For example, the point with Cartesian coordinates (-1, -1) has polar coordinates ($\sqrt{2}$,225°). Polar coordinate systems are also used in three dimensions.

*See* spherical coordinate system; cylindrical coordinate system.

# spherical coordinate system

A polar coordinate system in three dimensions. The location of a point P is made with reference to two axes at right angles taken from an origin (or *pole*) O. One coordinate is the *radius vector*, which is the distance OP from the pole to the point. The radius vector is given the symbol *r* (some-times ρ). The other two coordinates are angles measured with respect to two axes: the horizontal axis (corresponding to the *x*-axis of Cartesian coordinates) and the vertical axis (corresponding to the z-axis and called the *polar axis*). The plane of the two axes is called the *initial meridian plane*. The angle between the polar axis and the radius vector is the *colatitude* θ: the angle between the horizontal axis and the projection of the radius vector on the horizontal plane is the *longitude* ϕ. *The point P is specified by three coordinates, written as* (*r*, θ, ϕ).




**spherical coordinate system** Spherical polar coordinate system.

The colatitude θ may vary between 0 and π radians; the longitude may have any value but is usually taken between 0 and 2π radians. Spherical coordinates are used in studying systems that possess spherical symmetry; examples occur in field theory, spherical harmonics, celestial mechanics (*see* astronomical coordinate system), and atomic structure. The method of locating a point is similar (but not identical) to the system of geographical coordinates. Spherical

coordinates are also called *spherical polar coordinates*.

It is possible to transform from a spherical coordinate system to a rectangular Cartesian coordinate system. If the pole of the spherical system coincides with the origin of the Cartesian system, the polar axis coincides with the z-axis, and the initial meridian plane coincides with the $x$-$z$ plane, then a point $(r, \theta, \phi)$ in spherical coordinates has Cartesian coordinates given by

$$x = r\sin\theta\cos\phi$$

$$y = r\sin\theta\sin\phi$$

$$z = r\cos\theta$$

Similarly, a point $(x, y, z)$ in Cartesian coordinates has spherical coordinates given by

$$r = \sqrt{(x^2 + y^2 + z^2)}$$

$$\theta = \tan^{-1}\left[\frac{\sqrt{(x^2 + y^2)}}{z}\right]$$

$$\phi = \tan^{-1}\left(\frac{y}{x}\right)$$

where $\theta$ is such that $0 \leq \theta < \pi$ and the value of $\phi$ is such that

$$x : y : r\sin\theta = \cos\phi : \sin\phi : 1$$

xreferences

• polar coordinate system
The Penguin Dictionary of Mathematics
• Bessel functions
The Penguin Dictionary of Mathematics
• space coordinates
The Penguin Dictionary of Mathematics

adjacent entries

• cycloid
• cyclotomic polynomial
• cylinder
• cylindrical coordinate system
• cylindrical surface
• cylindroid
• cypher

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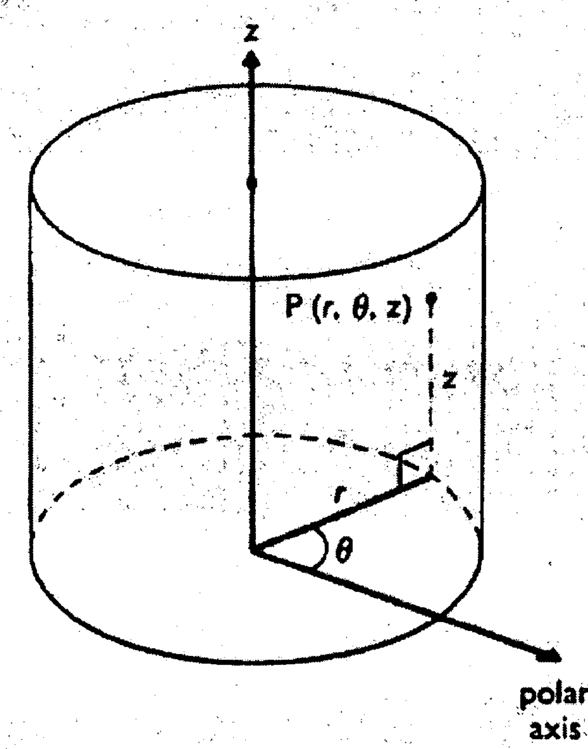
# cylindrical coordinate system

A polar coordinate system in three dimensions. Cylindrical coordinates have the two coordinates ($r$, $\theta$) of polar coordinates in




**cylindrical coordinate system**

a plane with an additional z-axis through the pole perpendicular to the plane. If $r$ is constant and $z$ and $\theta$ vary over all values, a cylindrical surface is generated.

It is possible to change between cylindrical and rectangular Cartesian coordinates. If the pole of the cylindrical system coincides with the origin of the Cartesian system, the polar axis coincides with the $x$-axis, and the z-axes coincide, then a point ($r$,$\theta$,$z$) in cylindrical coordinates has Cartesian coordinates given by

$$x = r\cos\theta, \qquad y = r\sin\theta, \qquad z = z$$

Similarly, a point (x,y,z) in Cartesian coordinates has cylindrical coordinates given by

$$r = \sqrt{(x^2 + y^2)}, \quad \theta = \tan^{-1}(y/x), \quad z = z$$

the value of θ being chosen so that

$$x:y:r = \cos\theta:\sin\theta:1$$